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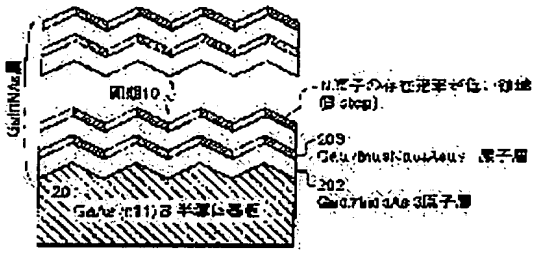
(71)Applicant : HITACHI LTD
(72)Inventor : KITATANI TAKESHI
KONDO MASAHIKO
TANAKA TOSHIAKI

(54) SEMICONDUCTOR LASER AND OPTICAL COMMUNICATION SYSTEM USING IT

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a semiconductor laser having a nitrogen-containing III-IV compound semiconductor layer in which PL peak energy does not shift largely even when the layer is subjected to annealing in manufacturing the laser.
SOLUTION: The semiconductor layer is provided with an active layer which generates light, a clad layer which confines the generated light, and a resonator structure which obtains laser light from the generate light. The active layer has the nitrogen-containing III-V compound semiconductor layer in which nitrogen atoms constituting the layer are arranged with fixed periodicity.

図 2



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[0012]

[Embodiments of the Invention]

An example of a specific process of periodically disposing N atom will be described. Herein, in order to describe the process of periodically disposing N atom, other processes are omitted. In the example shown in Fig. 1, a GaAs (100) substrate 101 is used as a growth substrate, and, $Ga_{0.7}In_{0.3}As$ 3 atomic layers 102 and $Ga_{0.7}In_{0.3}N_{0.04}As_{0.96}$ 1 atomic layer 103 are alternately disposed. By thus alternately stacking a plurality of different semiconductor layers with a thickness of several atomic layers, it becomes possible to periodically dispose layers in which N atom exists and layers in which N atom does not exist in a growth direction. When the number of periods is set to 10, a total film thickness is approximately 10nm. In this case, the film has a pseudo-composition equivalent to $Ga_{0.7}In_{0.3}N_{0.01}As_{0.99}$. In a quantum well structure in which the film is used as a well layer and GaAs is used as a barrier layer, a wavelength shift amount in annealing has been reduced from conventional 60nm to 30nm, and an emission of light in a 1.3μm band compatible with optic fiber communications has been achieved.

[0013]

Another example is shown in Fig. 2. Herein, a GaAs (n11) B substrate 201 is used as a substrate (n: positive integer). It has been reported that N atom hardly sticks to thus inclined B step position of the substrate, in the 46th Oyo Butsurigaku Kankeiren Koenkai Koen Yokoshu p. 48, 29p-T-6. Therefore, as in the above-described example shown in

Fig. 1, when $Ga_{0.7}In_{0.3}As$ 3 atomic layers 202 and a $Ga_{0.7}In_{0.3}N_{0.04}As_{0.96}$ 1 atomic layer 203 are alternately stacked in 10 periods, a region in which N atom exists and a region in which N atom does not exist are formed both in a growth direction and a direction perpendicular to the growth direction as shown in the drawing, and two-dimensional periodicity may be introduced to distribution thereof. In the structure of this invention, the wavelength shift amount in annealing has been reduced from conventional 60nm to 20nm with a GaAs (311) B substrate, and an effect larger than that in the example shown in Fig. 1 is obtained. To obtain larger effect, it is desirable to set n (the positive integer) of the substrate used to be as small as possible. When n is set to not larger than 10, sufficient effect will be obtained.

Fig. 1

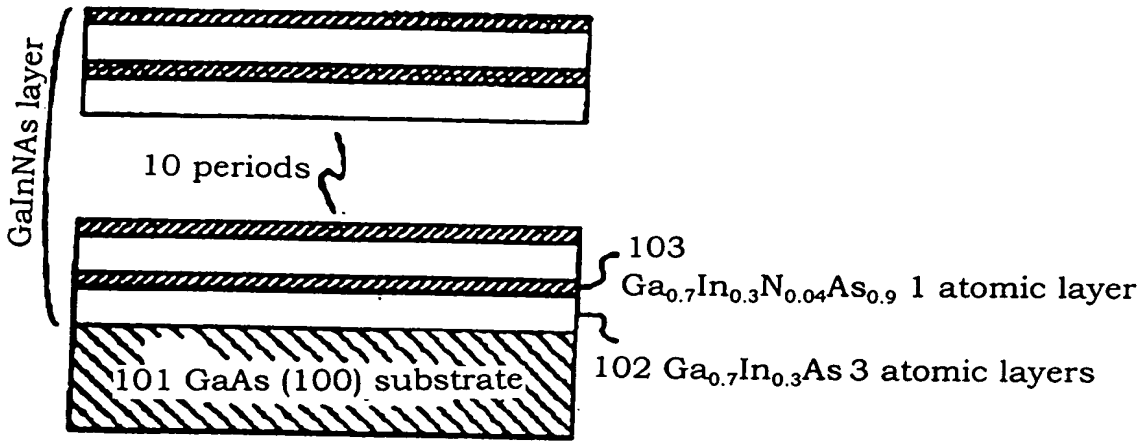
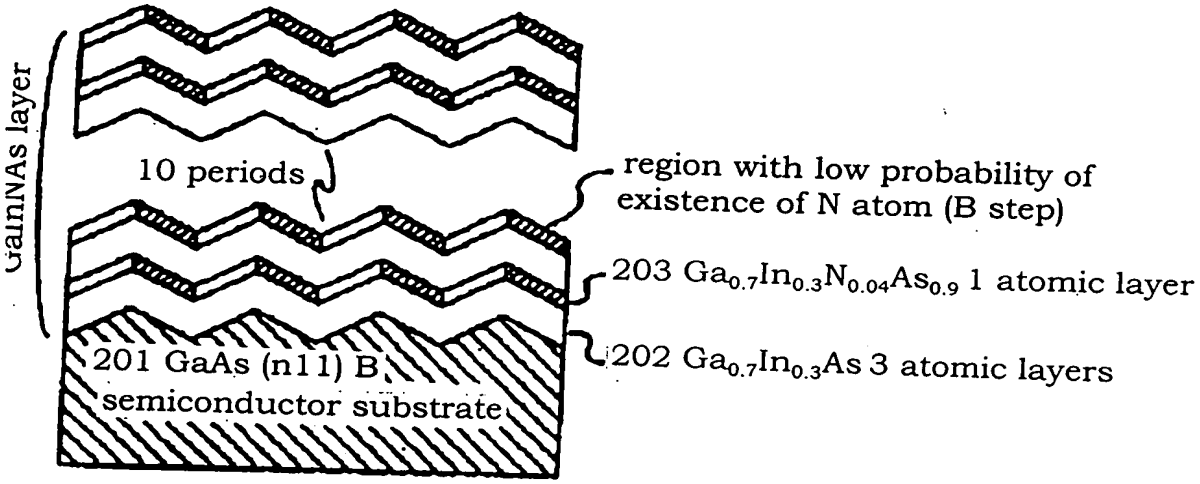

GaInNAs layer
10 periods
103
$Ga_{0.7}In_{0.3}N_{0.04}As_{0.9}$ 1 atomic layer
102 $Ga_{0.7}In_{0.3}As$ 3 atomic layers
101 GaAs (100) substrate

Fig. 2


GaInNAs layer
10 periods
region with low probability of existence of N atom (B step)
203 $Ga_{0.7}In_{0.3}N_{0.04}As_{0.9}$ 1 atomic layer
202 $Ga_{0.7}In_{0.3}As$ 3 atomic layers
201 GaAs (n11) B semiconductor substrate